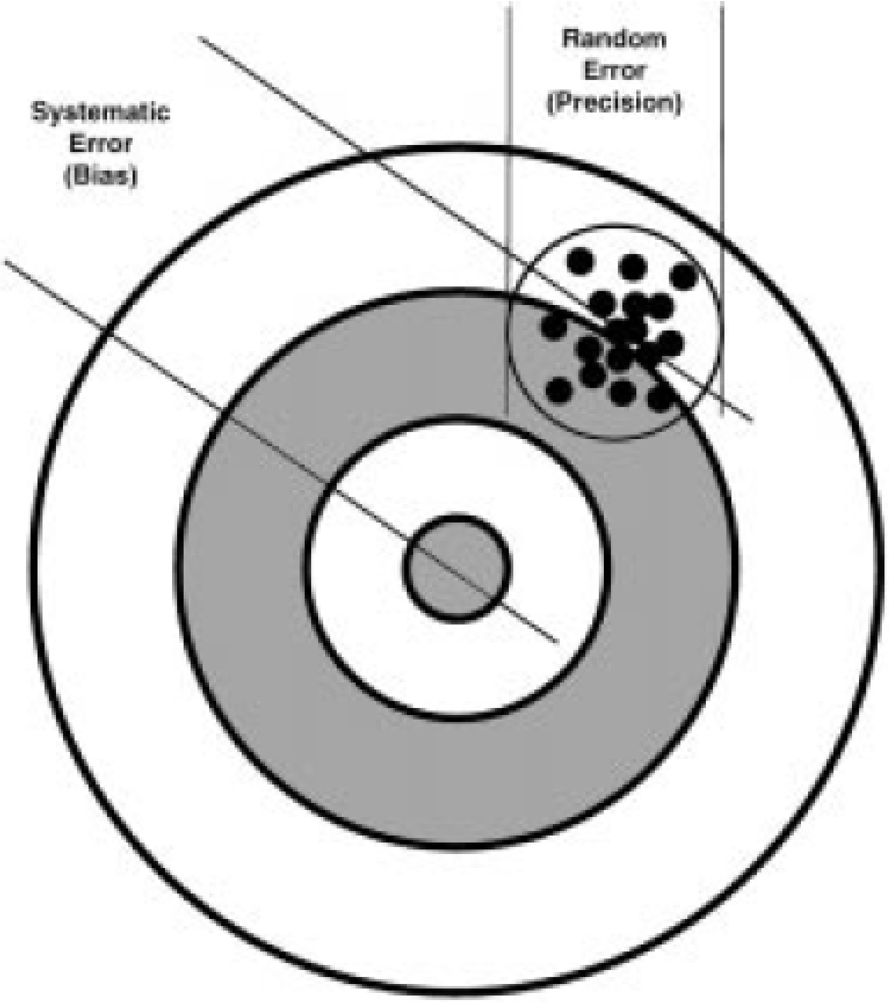
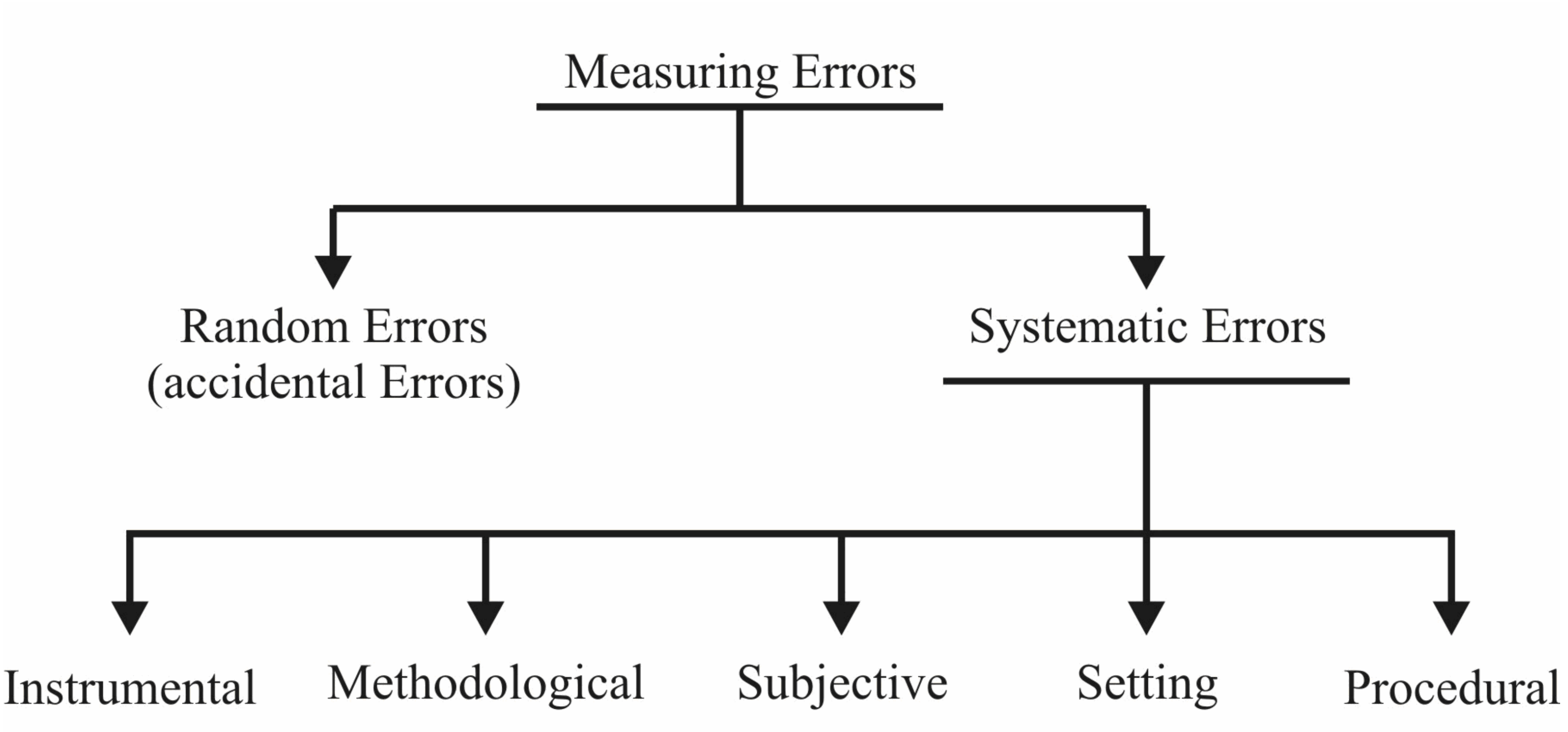
Classification of Errors (1)



Classification of Errors (2)



Random Errors (Noise)

- They are due to irregular causes and vary in a random manner when the unknown is measured repeatedly.
- The causes of random errors cannot be identified during a measurement or predicted in advance.
- Their presence can only be detected when the same quality is measured again under the same conditions.

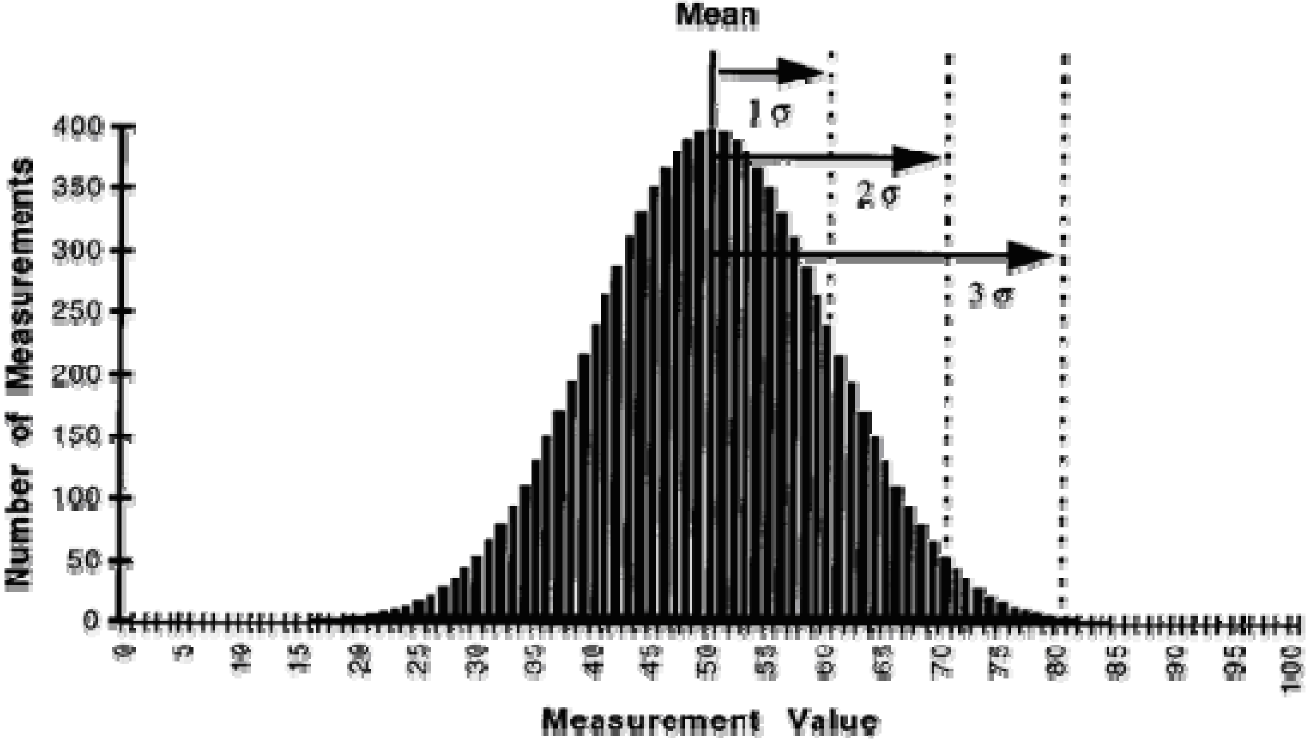
The main characteristic of random errors is that they vary in both magnitude and sign

Standard Deviation (1)

The precision of the measurement is normally quantified by the standard deviation (σ)

$$\sigma = \sqrt{\frac{\sum_{i=1}^{n} (x_i - X)^2}{n-1}}$$

$$\text{Mean} = \frac{\sum_{i=1}^{n} x_i}{n}$$

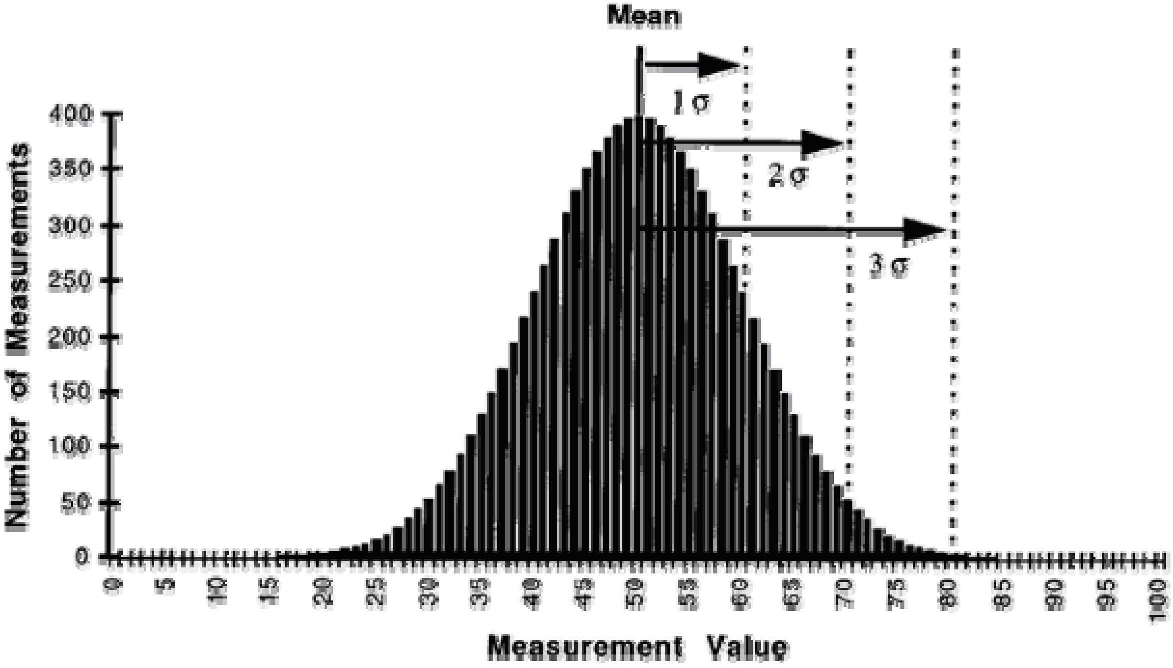


Standard Deviation (2)

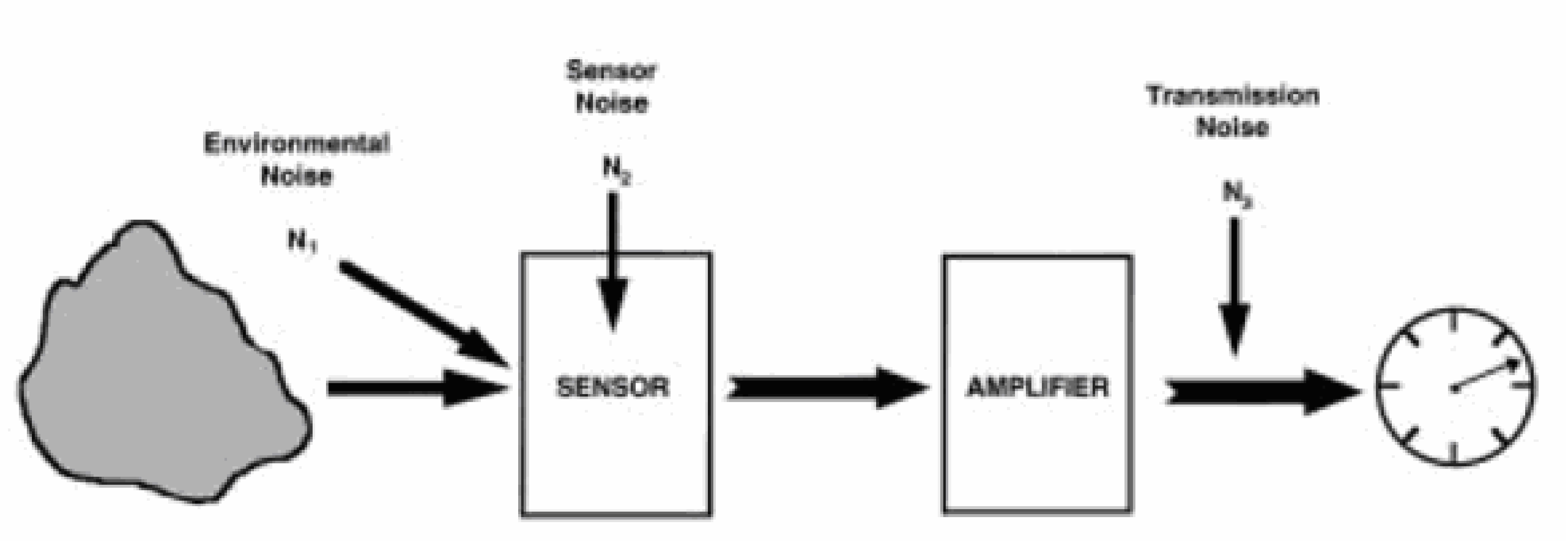
A total of

- ☐ **68% of the measurements will fall within ±1σ of the mean**
- ☐ **95% will fall within ±2σ**
- ☐ **99.7% will fall within ±3σ**

The smaller the standard deviation, the more precise the measurement.

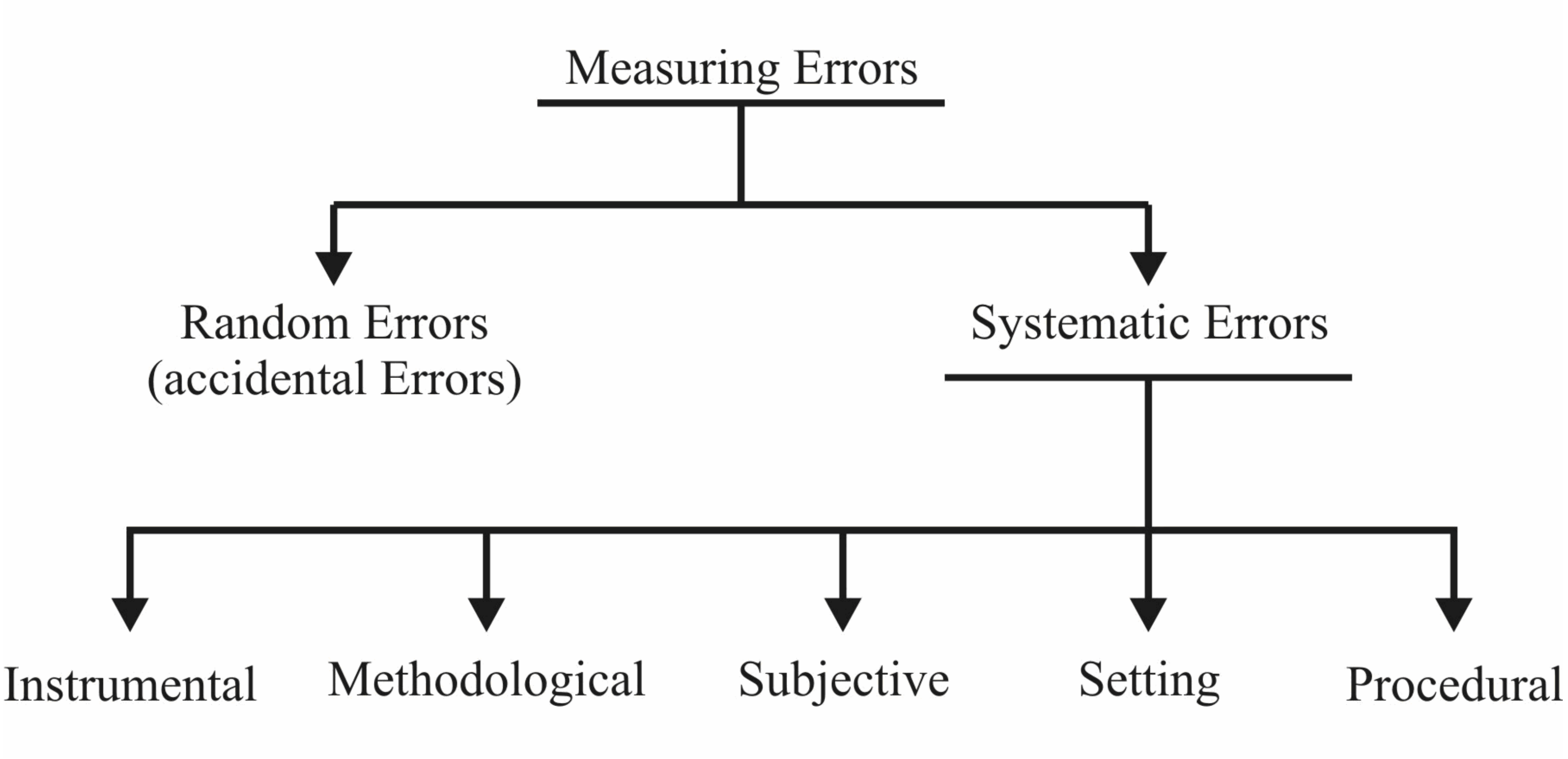


Sources of Noise



Somtimes the signal itself represents a source of random errors

Classification of Errors



Measuring Errors

Random Errors
(accidental Errors)

Systematic Errors

- Instrumental
- Methodological
- Subjective
- Setting
- Procedural

Systematic Errors

- ☐ They enter (generally) with the same sign and often with the same magnitude into the records.

- ☐ Therefore, they are most effective in disturbing the result.

- ☐ Systematic errors can be caused by imperfection of measuring methods, properties and errors of measuring instruments, Personal errors.

Instrumental Error

- This is sometimes called indication error.
- It is defined as the error obtained by subtracting the true value of the quantity measured from the indicated value.

Instrumental error may be caused by either:

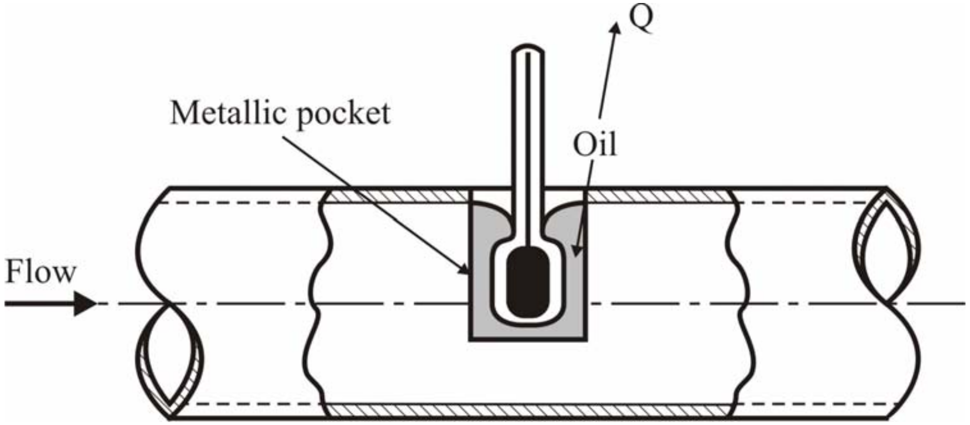
1. Manufacturing Errors
2. Design inadequacy

Methodological Error

- ☐ Its source lies in the imperfections of the measurement method chosen.

Methodological error may be caused by either:

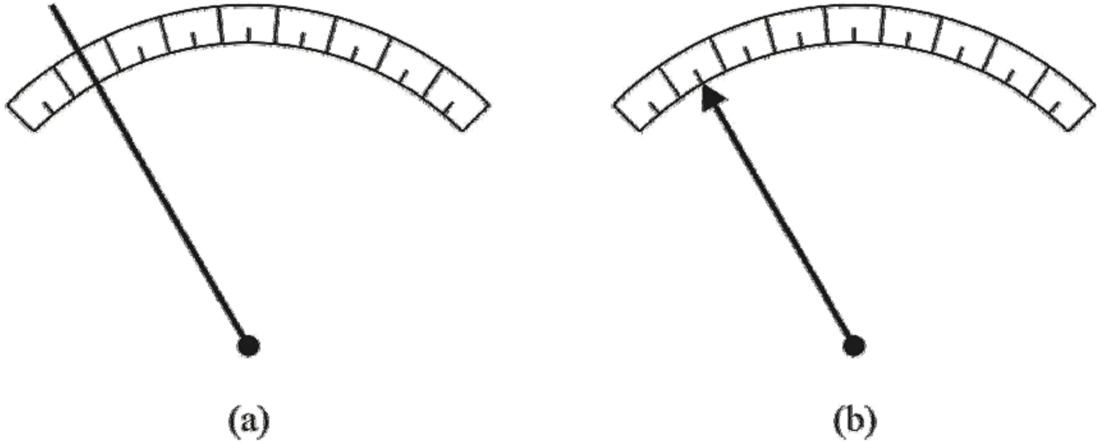
1. A new method is being used.
2. The method is based on approximate equations.



Subjective Error (1)

- ☐ known as the observation error or operating error.
- ☐ It is the error committed by the observer when reading the indication of an instrument. .

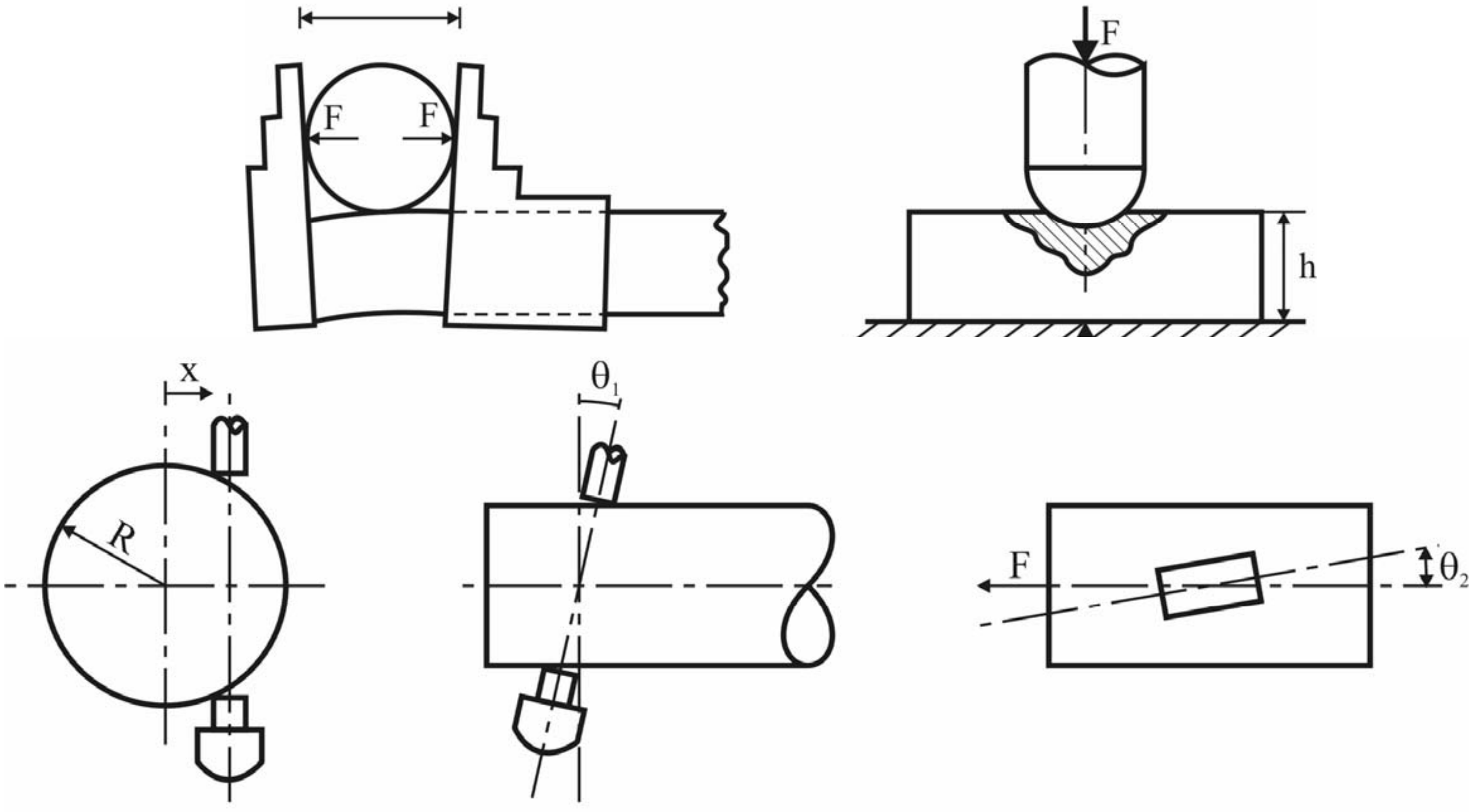
Subjective error may be caused by either:


(a) (b)

1. Simple misreading
2. Errors due to parallax
3. Faulty estimation of the fractional part of a scale interval

Subjective Error (2)

- Errors in size measuring instruments.



(a) (b) (c)

Setting Error

- ❑ It is the error that occurs when the instrument is improperly adjusted to zero prior to a measurement.

- ❑ or when the experimenter has not been careful enough in setting up his instrument by a level or a plumb-line, etc.

Procedural Error

- It is the error which arises out of the procedure or conditions under which measurements are carried out (ambient temperatures, pressures, etc.) .

- It is independent of the accuracy of the measuring means itself.

- It may be caused for example when a pressure measuring instrument is installed at a level below or above that of the measuring point.

Thank you!